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Actor-Network Theory (ANT) as an Interpretive Tool to Understand the Use of Online Technologies: A Review

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Abstract: The rapid development of ICT has become the catalyst to many creations of online technology worldwide. Online technology has become part of everyday activities for individuals, corporate bodies, institutions and government. However, there are concerns that the use of online technology has been restrictive in certain aspects. Although, studies to understand the facilitating and restrictive factors of using online technology have been varied and extensive, studies that recognize the multiple and interdependent factors could provide a better understanding of the use of a nascent technology, such as the online technology. As such, this paper presents a review of studies that adopts Actor Network Theory (ANT) as a lens to understand the use of online technology. Based on 110 papers selected from reliable databases, these papers were analyzed and categorized according to different domains. It was found that ANT has been used in nine domains, mainly the domains of culture and society as well as business. Further, three advantages of using ANT as a lens to understand the use of online technology have been identified, namely, its ability to explain a complex mechanism, identify failure factors and present a holistic picture with variety of interrelated factors. It can be concluded that ANT is an appropriate interpretive tool to understand the fluid usage of online technology.

Key words: Use of online technology, actor network theory, interpretive tool, halal certification, ANT, online technology

INTRODUCTION

The rapid development of Information and Communications of Technology (ICT) has brought to the creation and adoption of many online technologies worldwide. Many have argued that the adoption of online technologies has facilitated humans to perform their daily routine anywhere and anytime, resulting in the online technology becoming a part of everyone's life. Further, the widespread uptake of online technology has also been recognized in institutions as well as organization. Lee *et al.* (2015) asserted that ICT is continuously creating new types of markets and enabling new patterns of industry dynamics. In this case, online technology is viewed as a tool that facilitates efficient and effective work practice. Recognizing this potential, online technology has been increasingly adopted in e-Government, e-Banking/finance, e-Health, e-Learning and many other sectors.

Not with standing the recognition of its affordances, there are concerns that the potential usages of online technology are merely rhetorical assertions. In reality, the affordances of online technology have not been fully realized. Many have highlighted the restrictions in the use of online technology. Darrel and Martin highlighted three factors as barriers to the technology adoption which are the lack of institutional support, lack of financial support and lack of time to learn new technologies. Besides that, the demographic factor such as old age has also been traced as a reason of low technology adoption due to privacy concerns and lack of cognitive abilities to learn the technologies (Charness and Boot, 2009).

Studies that attempt to understand the restrictive usage of online technology have been diverse and extensive. For example, Se-Joon studied the understanding on the information technology usage behavior, Tony derived an understanding of the building blocks of online learning and Morteza aimed to get a better understanding of IT adoption in SMEs sector. Actor Network Theory (ANT) has become an increasingly recognized lens to understand the ways in which people use technology. In comparison to other methodologies, ANT is considered as a holistic lens that provides better understanding of the factors that influence and shape the use of online technology in a particular context. Unlike the methodologies that view actors as having a direct cause

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and effect relationship, ANT focuses on the understanding of the actors that shape and being shaped by each other in a particular system. In this case, ANT gives an equal voice to actors regardless the human or non-human actors.

This study aims to provide a critical literature review analysis on the use of ANT as a lens to investigate the use of online technology. This literature review is motivated by an effort to understand the use of e-Halal platform for online application of halal certification in Malaysia. Several studies related to halal certification in Malaysia have been conducted (Arif and Sidek, 2015; Hassan *et al*., 2014, 2015; Noordin *et al*., 2009) but studies related to e-Halal for application of halal certification has yet to be conducted. In this respect, this review focused on the selection of the studies is based on two selection criteria, namely studies that adopt ANT as the primary lens of interpretation and studies that investigate the use of online technologies.

Actor Network Theory (ANT): Developed primarily by bruno latour, michel callon and john law, ant is mainly known as enrolment theory or the sociology of translation that emerged during the mid-1980s. ANT suggested that the work of science is not fundamentally different from other social activities. It is a mechanism of telling a story and it can be presented as a complementary approach to information system studies which have also largely avoided technologically deterministic hypothesis of causality between ICT innovation and particular organizational or societal effects (Stanforth, 2006). It uses all significant factors including human and non-human factors of a system and finds the inter-correlated of understanding between each factor in the effort to get a comprehensive and understandable story of the whole system. ANT accepts the differences between human and non-human actors but denies treating them separately.

ANT distinguishes itself from other socio-technical approaches by considering both human and non-human elements equally as actors within a network (Stanforth, 2006). These networks can include humans, things, ideas, concepts all of which are referred to as actors" in the network (Cresswell *et al*., 2010; Dankert, 2011). This will lead to a holistic understanding towards a system: regardless of their nature as long as they affect the system, they are considered as significant actors that need to be understood. As such, each factor has equal treatment and interest regardless of their nature, either it is spoken or not, either it is visible or not. It is stated by Stanforth (2006) that understanding power relationships in ANT means describing the way in which actors are defined, associated and obliged to remain faithful to their alliances. It is important to recognize all actors in a system, in the sense that it can be seen or not seen in nature as even wind which is unseen can crack the trees.

Each of the actors has it own associations and the tracing of associations or relationships between network components (or actors) is a key activity in ANT (Latour, 1997). This will create another network and ANT will see how networks come to be larger and more influential than others, how they come to be more durable through enrolling both social and material actors and where power comes from and how it is exerted.

Considering the actors are continually influencing and shaping each other, all elements in the networks will undergo a translation process. Thapa (2011) stated that the translation process can enhance a deeper understanding of the interplay among various actors by providing the details of all strategies through which an actor identifies other actors and arranges them in relation to each other. Stanforth (2006) explained that the translation process is a mechanism whereby the network is progressively taking form, resulting in a situation where certain entities control the others. This is where we can see the active and loud entities and how it affects the passive and quiet entities in the network. The obstacles in each step of translation then will be identified and negotiated between each other to seek an obligatory passage point or "OPP" at the end of the translation process.

Callon stated that there are four phases involve in the translation process and these phases are not sequential and can be overlapped (Thapa, 2011). The four phases are discussed below.

Problematization: It is the process of the key actor identifies the other actors that can consist of human and non-human and define the problem and propose solution. Priyatma stated that the solution is met when all actors in participation will be subjected to some centralized control mechanism that named as "Obligatory Passage Point" (OPP).

Interessement: Callon mentioned that it is the group of action where the entity attempts to impose and stabilize the identity of other actors it defines through its problematization. Gunawong and Gao mentioned that it is a series of processes where a focal actor attempts to lock other actors into a position that has been offered to them in the network. This is the step

whereby all actors are given with specific roles and identities and the strategies needed that lead them to the next phase.

Enrollment: Callon stated that it is the set of strategies in which a focal factor attempts to define and inter-relate the various roles that allow other actors to enroll. The stability of the alliances and actors in the network depends on the negotiation process in defining their roles within the network.

Mobilization: Stanforth (2006) mentioned that this is the stage where the principal actors borrow the force of their passive agent allies and transform themselves into their representatives or spokesperson. Priyatma explained that mobilization is the phase when the proposed solution is being accepted and then a larger network of absent entities are created through some actors acting as spokesperson for others.

Besides giving positive contributions to many areas of study, ANT also faced some controversies. Shim and Shin (2016a, b) highlighted that ANT was criticized due to its descriptive characteristic feature that would cause a short interpretation or explanation of the analysis. This is also highlighted by Heeks and Richard Heeks that ANT does describe everything but nothing is explained. This situation has led some of the researcher to combine ANT with other theories just to earn more points to strengthen their explanations. Besides, it stated by Samarawickrema adn Stacey (2007) that ANT has controversies in devaluating human as it has been treated equally as the machine. However, it is just a part of the methodological protocols and does not defeat the actor's knowledge and practice according to its nature of existence.

On the other hand, ANT has also been criticized for being difficult to be put into practice as it has been seen written in a book-length thick description despite many researchers prefer the short-term research. This situation exist because ANT is usually referred as epitome studies such as Latour (1997). However, many recent studies have proved that ANT is not supposedly presented in long-written text. Further, several researchers (Cresswell *et al*., 2010; How and Alawattage, 2012) have argued that it is difficult to test with empirical evidence due to its broadness. Although, there have been criticism regarding ANT, it is a valuable lens that provides deep insights in any form of networks regardless of its complexity and tackling the complexity to ensure continuous stability and evolution. It is also need to be sure to use ANT in exploratory research areas that is not being explored much and ANT can come up with new and unexpected conclusions (Dankert, 2011).

MATERIALS AND METHODS

ANT has been used in many researches that attempt to provide a nuanced understanding of the usage or adoption of online technology in a particular context. This study provides a review on the use of ANT as a lens to understand the usage of online technologies in various domains. This study describes the procedures of the review. The review processes can be summarized by the Fig. 1. As shown in Fig. 1, the review was conducted in two phases: Phase 1 focuses on the protocol of the data selection and Phase 2 focuses on the data analysis and reporting. The descriptions of the two phases are presented below.

Phase 1; Protocol for data selection: Phase 1 focuses on selecting the most relevant studies for the review. This begins with searching for relevant studies using the keyword "actor network theory" from reliable digital library databases, such as Sciencedirect, scopus, elsevier and ACM digital library. Due to the extensive number of researches found, we refined our search based on the recent 5 years publication which is from 2012-2016. We then examined the titles and abstracts to select the studies that adopt ANT as their method of analysis. From this search technique, we identified 110 papers. We further imposed two levels of selection criteria. The two selection criteria and the number of papers involved in each of the selection criteria are shown in Fig. 2.

The first level of selection criteria involved identifying papers that utilize ANT as a primary tool of investigation. For this purpose, we differentiated the studies into two categories: studies that adopt ANT as a primary lens of investigation and studies that use ANT as a secondary lens. As shown in Fig. 2, 86 papers were identified to utilize ANT as the primary lens. However, only 24 papers utilize ANT as a secondary lens and these papers were excluded from our review. The second level of selection focused on the identifying papers that use ANT as a major lens of investigation of the use or adoption of technologies. This criterion was chosen based on the fact that the purpose of this review is to investigate the use of ANT as a lens to understand the usage of online technology. In this case, papers that use ANT to investigate other than the use of technologies were excluded. Specifically, papers that investigate such as the adoption of new policies or practices, environment

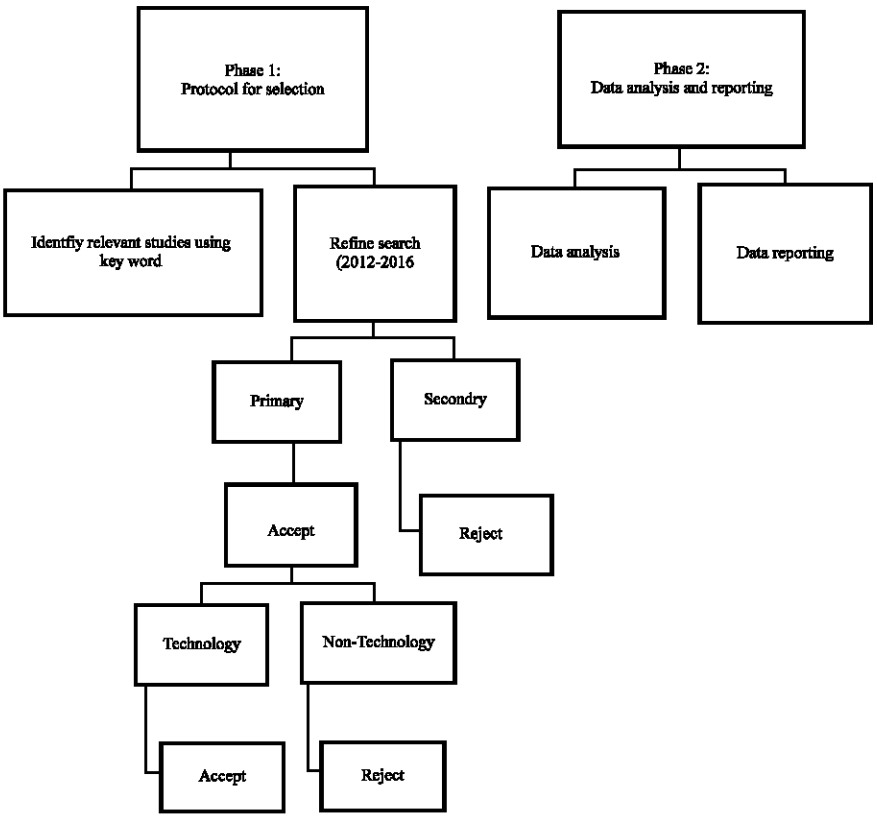

Fig. 1: The review process

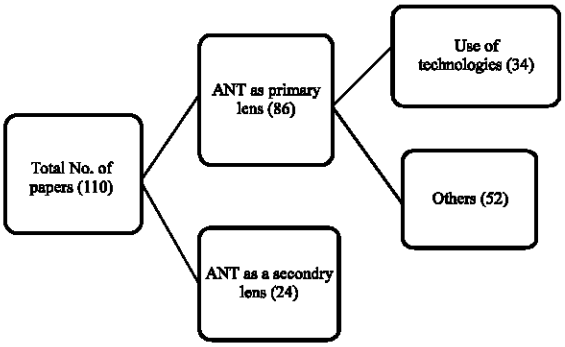

Fig. 2: The selection criteria of the review papers

(forestry, agriculture and farming) management and behavior understanding were excluded. As shown in Fig. 2, 34 papers were found to use ANT as a primary lens to investigate the usage of online technologies. Meanwhile, 52 papers were found to use ANT as a primary lens to investigate other than the usage of technologies. In this case, these papers were excluded from our review. Hence, the selection of the most relevant studies was finalized to 34 papers only. These papers were then further analyzed in the second phase of this review.

Phase 2; Data analysis and reporting: The review presented in this study is primarily based on the 34 papers drawn from the two levels of selection described above. To investigate the use of ANT as an interpretive tool of the use of technology, these papers were analyzed and categorized based on two aspects. Further, the identification of the various domains that adopt ANT as a lens was also conducted to the 110 papers. The second aspect of analysis focused on the use of ANT for the purpose of understanding the use of online technologies. The results of the analysis are presented below.

RESULTS AND DISCUSSION

This study presents the findings and discussion based on the analysis conducted on the 34 papers published from 2012-2016. The adoption of ANT has been widely used, since it was introduced and it does not only cover social and technology areas but also many other fields of knowledge. Its diasporas has spread to sociology, geography, management and organization studies, economics, anthropology and philosophy.

Table 1: Studies that use ANT as a lens of investigation (2012-2016)

	ANT adoption		
Domains	Primary	Secondary	Total
Culture and society	29	7	36
Business	16	3	19
Products	9	-	9
Energy	7	3	10
Education	7	3	10
Health	6	1	7
Internet of Things (IoT)	5	5	10
Management	4	1	5
Tourism	3	1	4
Total	86	24	110

Classification of ANT as interpretive lens based on different domains: As there have been extensive studies that adopt ANT as the interpretive tool, we first categorized the 110 papers according to nine domains, namely the culture and society, business, product, energy, education, health, Internet of Things, management and tourism. The distribution of papers according to the nine domains is as shown in Table 1.

Based on the 110 papers, ANT has been mostly adopted in culture and society field (36) as it is originally assigned for social studies (Okano, 2016). This is followed by business (19), energy (10), education (10), IoT (10), products (9), health (7), management (5) and tourism (4). The identification of the domain is further conducted for the papers that use ANT as the primary tool of investigation. Based on the 86 papers, ANT as a primary tool is found in in culture and society (29) followed by Business (16), products (9), energy (7), education (7), health (6), IoT (5), management (4) and tourism (3). Based on this pattern, we can conclude that the ANT is used as an interpretive lens in mostly culture and society as well as business. ANT is less used in the domains of tourism and management. Further, ANT has also been increasingly used for the investigation of the use of IoT (Table 1).

Considering that the focus of our review is to identify the use of ANT as interpretive lens for online technology, the classification of domains of the studies that use ANT as an interpretive lens is also differentiated according to the use of online technology and non-technology. These classifications are summarized in Table 2.

It was found that 20 studies involved investigation related to online technology while only 13 studies investigate non-technology used ANT as their interpretive lens. Based on the classification of domains for the studies related to online technology, we identified that ANT has been used as interpretive lens in the domains of IoT, business, education, tourism and management. Meanwhile, ANT has been used in both online technology and non-technology in studies related to the domains of product, culture and society and health. Additionally, no study was found to use ANT in the domain of energy. It can be concluded that the investigation of online technology that uses ANT as its lens is mostly in the domains of products, IoT, business, health and education.

Besides the classification, the analysis of the studies involved the identification of three emerging themes that relate to the strengths of ANT as a lens to understand the use of online technology. The three themes are explained below.

ANT as a tool for understanding provider/enhancement of online technology mechanism: Most of the studies that use ANT as interpretive lens have proven that it can be used to explain the complex mechanism of online technology, thus it untangled the complexity of the network. This contribution was common in all the studies that use ANT as the interpretive lens, ranging from studies related to information system, web portals to technology devices. Johannesen *et al.* (2012) argued that ANT has provided more contextual understanding from the findings of the analysis. Besides, it is also possible to derive an understanding of the interactions between heterogeneities actors in the study (Ackerman *et al.*, 2012). Ranerup (2012) emphasized that ANT affiliates both the human and non-human actors in the processes of technological performance. Both are depending on each other to make things work and every actors involved constitute a network that will be examined and analysed to see how it is constituted and unfolded (Sorensen *et al.*, 2015). These mechanisms have facilitated ANT to explain further the "what" questions that are capable to answer "how" and "why" questions. It is important to understand the roles of each actor in the network of the online technology as it will guide the technology developer to build a technology that has a quality and stable elements, thus avoiding the chances of failure or malfunction of the technology in the future.

By understanding the processes and the interactions, ANT can be used to explain how the mechanism works. This approach has attracted many researchers in the social science study to pick ANT as their method of study, especially when it is used to answer the "how" and the "why" questions in a social structure. According to Bettany *et al.* (2014) the adoption of ANT from science, technology and society disciplines can provide valuable theoretical insights of the ambivalence construction. So, the adoption of ANT in any domain of study can be

Table 2: Studies using ANT for the online and non-online technologies

	Researchers/Year published	
Domains	Online technology	Non-online technology
Products	Sorensen *et al.* (2015), Burkland and Zachariassen (2014)	Shim and Shin (2016 a, b), Sarpong *et al.* (2016)
Energy	-	Fatimah and Arora (2016), Nurlail *et al.* (2012), Nyborg and Ropke (2015), Nurlaila *et al.* (2015) and Am (2015)
IoT	Shin (2016), Ahn (2016), Shirazi (2014), Dery *et al.* (2013) Trkman and Trkman, 2014)	-
Business	Shim and Shin (2016 a, b), Sarosa (2012), Lee *et al.* (2015) Lowe *et al.* (2012)	-
Health	Ranerup (2012), Ackerman *et al.* (2012)	Infection Prevention and Control (IPC) (Attieh *et al.*, 2014)
Culture and Society	Bettany *et al.* (2014)	(Brown and Pena, 2016; Thorvaldsen and Annie, 2014)
Education	Ghazinoory and Hajishirzi (2012), Johannesen *et al.* (2012), Tvenge and Martinsen (2016)	-
Tourism	Lugosi	-
Management	Pollack *et al.* (2013)	-
Total	20	13
		34

applied if it is involved the interactions between human and non-human and the many uses ANT to find a nuanced explanations on the using of online technology.

ANT as tool to reveal the lagging factor of the online technology: The use of ANT in revealing the lagging or failure factor of the online technology also has proven in many studies. Tvenge and Martinsen (2016) discussed that ANT can be useful in mapping the processes the implementation effects of such technology. According to Shirazi (2014), ICT has assisted to provide more effective and efficient way of services delivery. ANT is capable to elicit the failure factor and highlighted the obstacle faced by the actors within the network for the success implementation of the technology. Dery *et al.* (2013) believed that ANT has the key concepts that benefit the information system studies as it can trace the lost from the desired stable network formation. This is usually highlighted in the problemmatization stage, whereby the key actor defines the problem and proposes solution to the addressed problem (Dery *et al.*, 2013). It will be discovered more in the next stages of translation where the actors within the network present some interests and barriers to the overall stability of the network. The obstacles to reach the OPP are detected, thus enabling the definition on the nature of the problem and the roles of other actors to fit the proposed solution.

Many studies managed to trace the lagging or failure factors of the online technology they adopted. IT covered information system studies (Burkland and Zachariassen, 2014; Dery *et al.*, 2013; Mahama *et al.*, 2016; Trkman and Trkman, 2014), use of technology devices studies (Ackerman *et al.*, 2012; Tvenge and Martinsen, 2016), network studies (Shin, 2016; Shirazi, 2014) and many other online technology related studies.

ANT as tool to guide the construction of online technology: The use of ANT as a guidance in the construction of online technology is crucial at the planning stage of technology development. ANT stressed that everything that may consists of research evidences, technologies, financial resources, institution and regulation acts should act together for any innovation processes (Shim and Shin, 2016a, b). So, by combining all relevant actors in one analysis, a unite objective could be set and collectively be achieved. It is also supported by Sarosa (2012) that ANT can be the most suitable methods to examine the interactive processes between the factors within a network, thus giving more comprehensive perspectives on such innovation. Ranerup (2012) stressed that the ANT can be used to handle the development process that involved the envisioning the future, deriving concrete ideas on the functions and platform of the technology, give understanding to diverse interests, highlight the potential political concerns and breakdown and working to make the idea into reality. The adoption of ANT is also argued to be practically suitable at the planning stage as it leads to more extended, realistic and precise understanding of how networked innovation processes evolved by Hoholm and Olsen (2012). Besides, ANT also could allow tracing the issues that emerge during the planning stage and open it for further examination and analysis (Lowe *et al.*, 2012). This could lead to less failure as well as determining the suggested solutions to any problem or issue that may encounter when introducing a new technology.

CONCLUSION

ANT has brought three major contributions to the analysis of study. It can be highlighted that it has benefitted the field of online technology in the formation processes, revealing the failure factor and also provided a harmony, nuanced and comprehensive understanding of the online technology mechanisms. Besides, it has

proved that ANT is applicable to be used in many domains of studies. The domain of studies are IoT, business, education, health, products, management, culture and society and tourism. Moreover, the adoption of online technology of these domains can be categorized into the main categories of online technology such as information systems, website portals, devices, networks and others. ANT untied the complexity of the network on those online technology applications and this could ensure to bring the sustainability of the online technology adoption in the future.

Further, the review also revealed that ANT has not been used as an interpretive lens to understand the use of e-Halal applications. Thus, it is suggested that an investigation of e-Halal applications using ANT as an interpretive lens would provide valuable insights on a nuanced understanding of the adoption of e-Halal application in Malaysia. It is anticipated that ANT as interpretive tool has the capability to handle the complexity of the e-Halal application. Hopefully, ANT could bring positive outcomes to address the heterogeneities underlined in online halal application system, thus it helps to increase the efficiency in halal management and registration which eventually encourages users to use the system.

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